Space Weather Technical Forecast

Issued on Sunday, 18 August 2024 at 01:19 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: G1 Minor Storms remain possible early day 1 (18 Aug). Occasional M-class flares expected, with a chance of X-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with four M-class flares observed, the largest an M1.6 from AR3784 at 17/1033 UTC. This is the most notable region of the ten currently on the visible disc, located in the northwest quadrant. Despite its moderate size and limited recent activity, this region has a persistent delta spot resulting in an atypical north-south orientation. Some growth of small spots has occurred on its northwest periphery, however some of its other surrounding spots, including some of those to the south, have decayed. Some recent growth has also be observed in AR3785 in the southwest, more notably in AR3790 in the southeast, and also in the two sunspots in the northeast, AR3793 and AR3794. A further notable region may also be rotating on the eastern limb, which was the source of a recent M-class flares.

A broad coronal reconfiguration was evident across the northern portion of the disc in SDO aia-211 imagery from around 17/1030 UTC, with a subsequent coronal mass ejection observed. This is expected to pass north of Earth on day 4 (21 Aug), however a glancing influence cannot be completely ruled out. No other Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: The X1.1 flare CME from 14 Aug arrived at 17/1330 UTC. Solar winds rose from background speeds, below 350km/s, to be slightly elevated at 430-480 km/s. Density also rose sharply, to above average with the arrival, and then well above average for a time 17/1630-2100 UTC, peaking at 67 pfu. Interplanetary Magnetic Field, Bt, was initially Weak, at 5-7nT, but rose sharply with the arrival to be Strong at 17-25nT. This declined after 17/1645 UTC to vary erratically between weak to strong levels, of 7-17nT. The north-south component, Bz, was also weak until the CME arrival, then varied turbulently between being strongly southward with minimum -22nT, and strongly northward with maximum +23nT. After 17/1705 UTC, the north-south component became weak, varying between +7 and -7 nT, with a trend to mainly positive (northward) values. Phi angle was mainly positive (away from the Sun) until 17/1622UTC, then became predominately negative (towards the Sun). This perhaps suggesting some influence from the northern coronal hole CH58/-. Geomagnetic activity was Quiet at first, but rose to G1 Minor to G2 Moderate storm 17/1500-2359. The interval 17/1500-1800 was reported at G3 Strong storm, but has subsequently been downgraded to G2.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 remained at Background. High energy electron flux (greater than 2MeV) observed at GOES16 was at Background. The 24-hour fluence was below the Active threshold, with 2.99e6 integrated pfu observed at 18/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate to High activity expected with further occasional M-class flares, and a chance of isolated X-class flares.

Solar Wind /Geomagnetic Activity: There are no Earth directed CMEs, however the broad coronal reconfiguration CME off the north-disc on 17 Aug has a slight chance of giving a

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glancing arrival on day 4 (21 Aug). Otherwise ongoing CME effects, perhaps enhanced by some interaction from any fast wind from the northern coronal hole CH58/-, are possible early on day 1 (18 Aug) before easing later in the day. Solar winds then easing to background day 2 (19 Aug) onward. Mainly Quiet conditions expected, however there is a chance of Active to G1 Minor Storms from any ongoing CME influence early on day 1 (18 Aug).

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at Background, with a slight chance of breaching S1 Minor solar radiation storm level should any notable flares occur, primarily from AR3784 or AR3780 from over the southwest limb. The high energy electron flux is expected to remain at background at first, but with a chance of increasing to Moderate at times as solar winds ease later in the period. The associated 24 hour fluence is expected to be below the Active level.

Figure 1a. BGS Geomagnetic activity

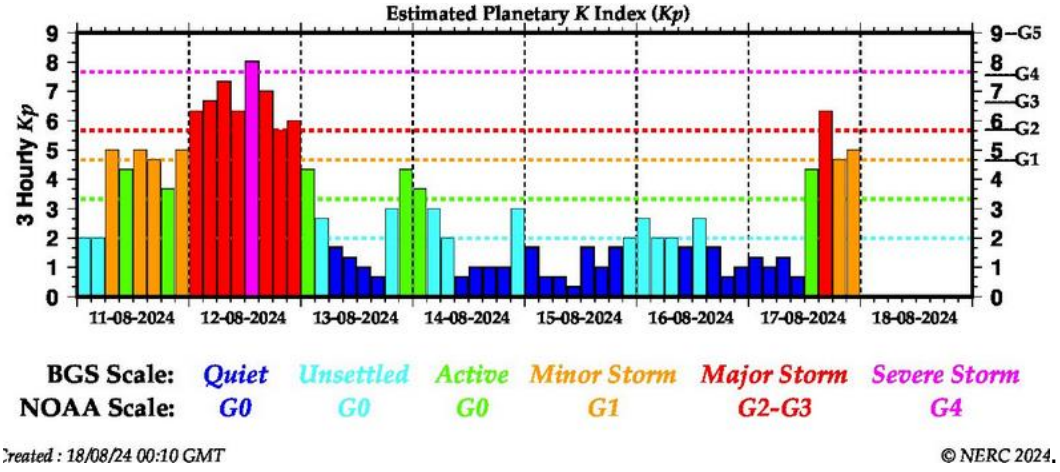

Figure 1b. Current Solar winds

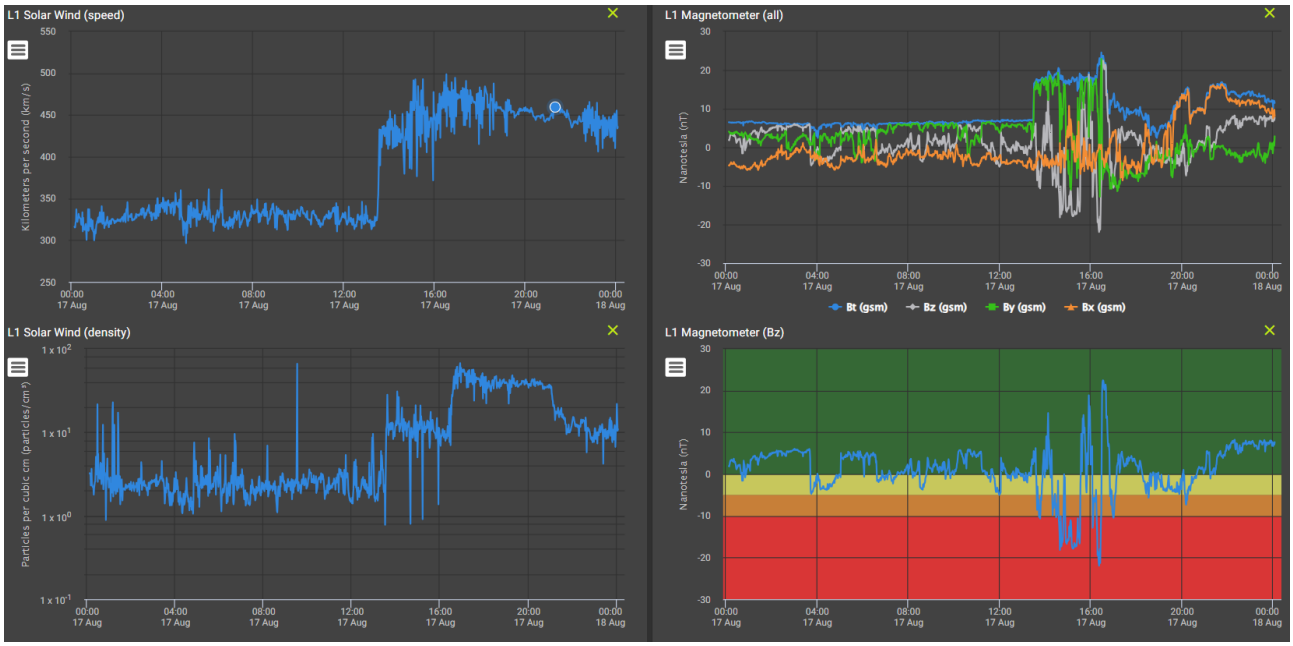

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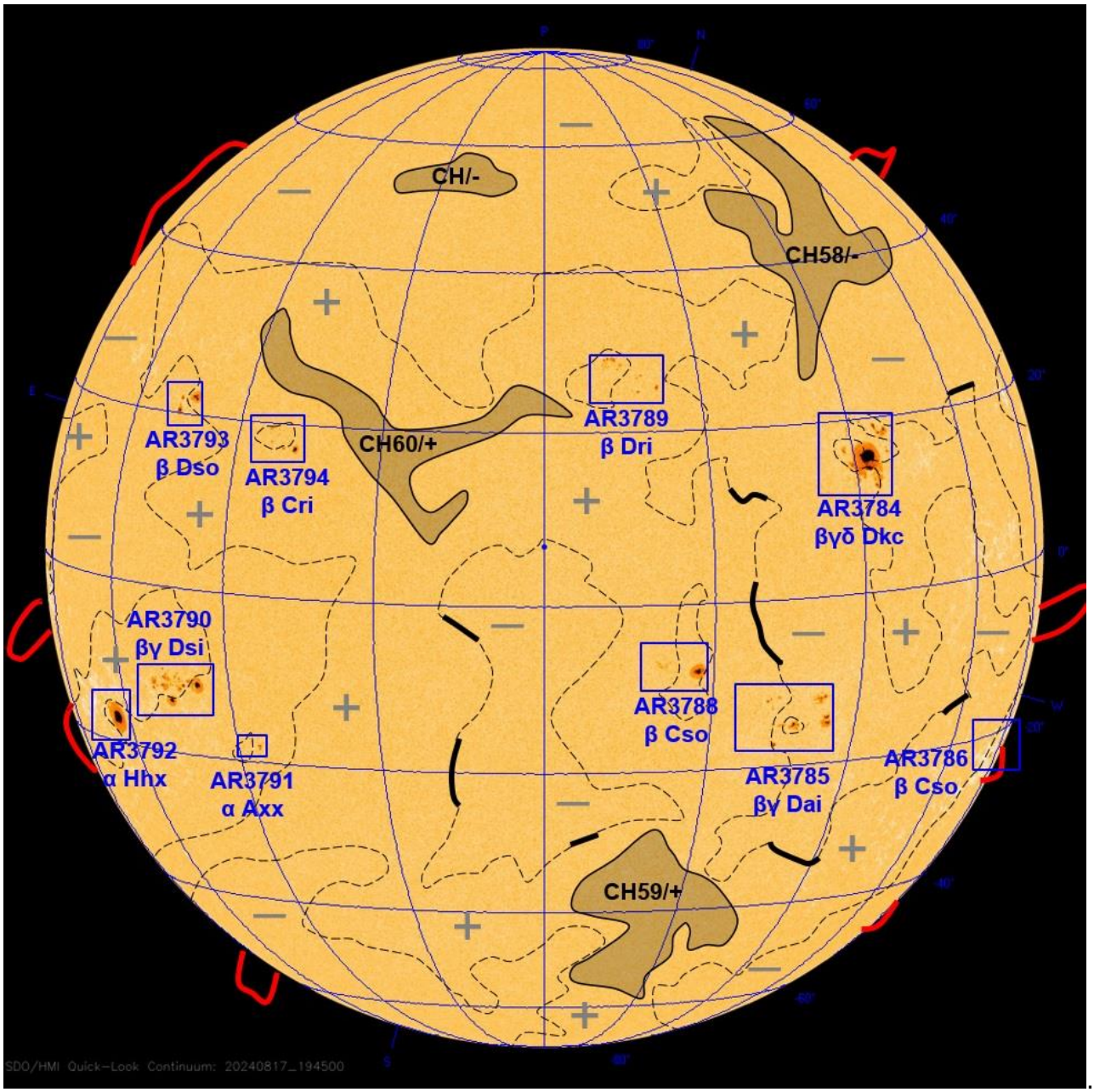
Figure 1b. Solar Analysis Valid 17/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

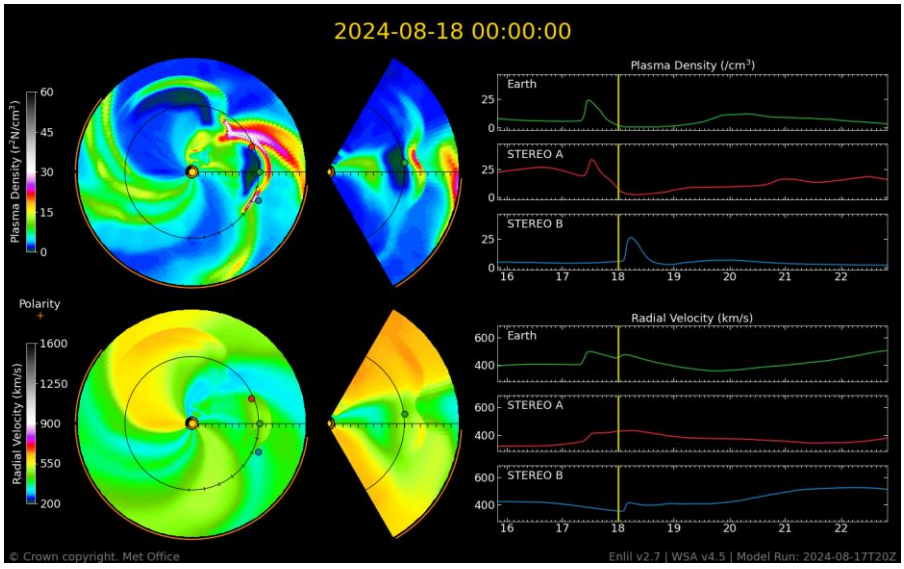
Ongoing CME affects are possible at first on day 1 (18 Aug), after arrival of the X1.1 flare CME that left the Sun on 14 Aug. The only other CME of note appears to be from a broad upper coronal reconfiguration, occurring from around 17/1030 UTC. This resultant CME is likely to pass north of Earth, but has a small chance of giving glancing impacts on day 4 (21 Aug).

Alongside the CME, it appears likely that Earth is seeing some influence from the northern disc coronal hole, CH58/-. Any fast wind influence from this feature is likely to gradually ease later day 1 (18 Aug), with mainly background winds expected to return from day 2 (19 Aug) onward. No further enhancement are indicated.

There remains a chance of G1 Minor Storms early on day 1 (18 Aug) given the current slightly elevated winds and Moderate IMF. Geomagnetic activity then likely easing to mainly Quiet to Unsettled day 1 (18 Aug), then mainly Quiet with only isolated Unsettled intervals day 2 onward (19 Aug). There is a slight chance of Active to G1 Minor storms day 4 (21 Aug) if any CME glance is observed.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	Yes	30	1	1	5
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

Figure 2: MOSWOC Enlil



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Radio Blackouts - X-Ray Flares:

There are ten sunspot regions on the visible disc. AR3784 remains the most likely significant flare source, despite its relative modest side and lack of recent notable activity. This has maintained a persistent strong delta spot to the south of its main umbra region, and sunspots with this north-south configuration have historically been known to produce some of the larger flares. However, given the relative small size and lack of activity, this is now considered only a low likelihood with this region.

The other regions are generally smaller, but there has been a recent growth trend in both AR3785 in the southwest and AR3790, both of which have more complicated beta-gamma magnetic structures. Growth has also been ongoing in the simpler region in the northeast, AR3793 and AR3794. There is also a new region rotating onto the east limb, that has yet to be analysed, but has been the source of at least one of the recent M-class flares. These regions also contribute to the ongoing flare potential.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	80	80	80	80
Very Active	R3 to R5 X Class	No	25	25	25	25

Figure 3a: GOES-16/18 X-ray flux

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Figure 3b: AR3876

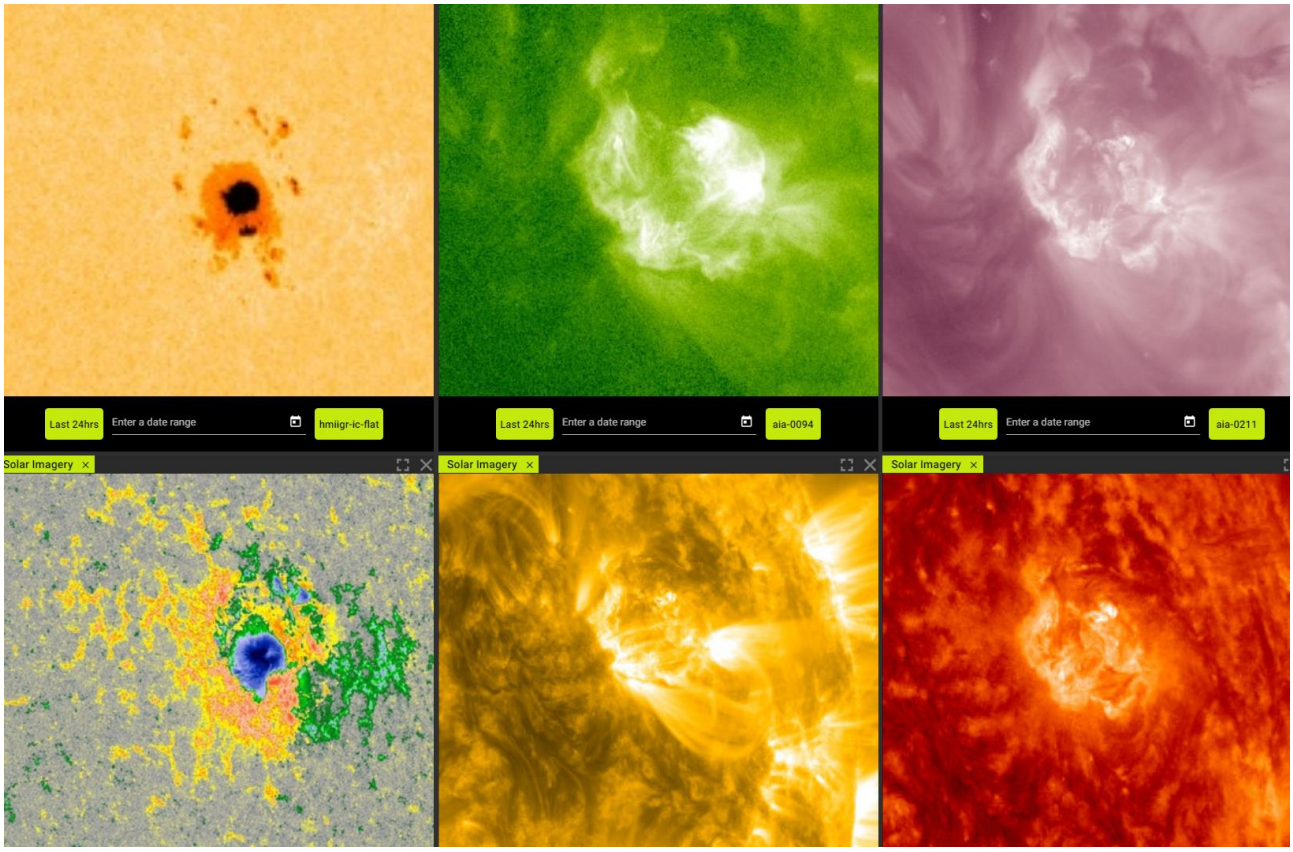
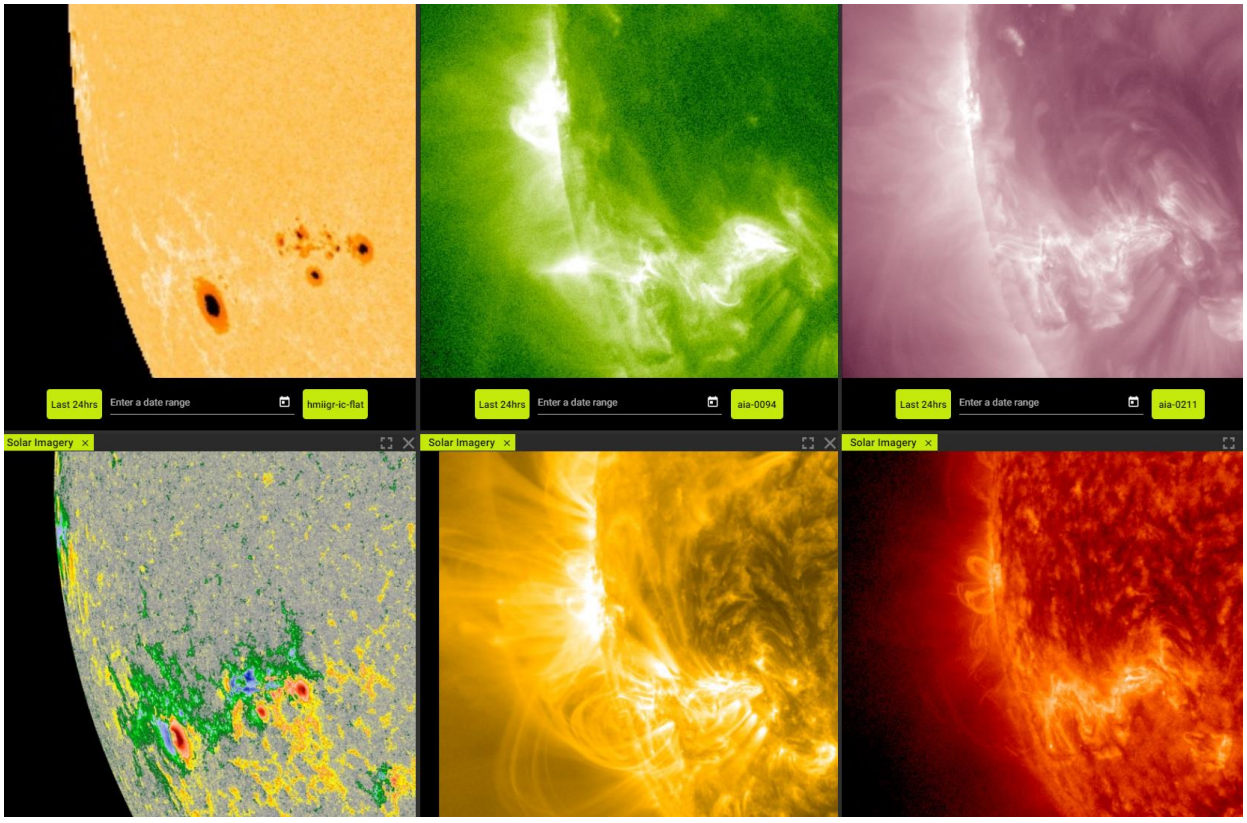


Figure 3c: SE disc, including (left to right), new region rotating on, AR3792 and AR3790



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Solar Radiation Storms - (High Energy Protons):

High energy proton flux at GOES-18 is expected to persist at background, but with a chance of rising in response to any notable flares. These most likely from AR3784 on the northwest visible disc, but potentially also from AR3780 early in the period, with this region now just over the southwest limb. There are also a few other regions on the western disc that could develop further and bring the potential for increases in the proton flux. Any rise will bring a slight chance of reaching the S1 Minor Radiation Storm level, and potentially higher, given the non-zero chance of a larger X-class flare.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	20	20	20	20
Very Active	**≥ S3 ***	No	5	5	5	5
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy flux, observed by GOES-16, is most likely to continue at background at first, with recent CME arrival likely having subdued any Moderate electron flux that may have been induced after the geomagnetic storming on 12 Aug. However, as slightly elevated current solar winds ease, there is a chance of moderate levels returning, perhaps approaching High at diurnal peak.

The associated 24 hour electron fluence is forecast to remain below Active, but could see a rising trend later in the period. MOSWOC REFM is currently showing a relatively flat trend, however this likely isn't taking account of the recent elevated solar winds from the CME arrival, and possible coronal hole interaction.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	5	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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